PRVD2008-27

Proposed Re-evaluation Decision

Didecyl Dimethyl Ammonium Chloride Cluster (DDAC)

(publié aussi en français)

12 November 2008

This document is published by the Health Canada Pest Management Regulatory Agency. For further information, please contact:

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ISBN: 978-1-100-10978-7 (978-1-100-10979-4)
Catalogue number: H113-27/2008-27E (H113-27/2008-27E-PDF)

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Overview

What Is the Proposed Re-evaluation Decision?

After a re-evaluation of the didecyl dimethyl ammonium chloride (DDAC) cluster, Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* and Regulations, is proposing continued registration of products containing DDAC for the sale and use in Canada.

An evaluation of available scientific information found that products containing DDAC do not present unacceptable risks to human health or the environment when used according to label directions. As a condition of the continued registration of DDAC uses, new risk-reduction measures must be included on the labels of products. No additional data are being requested at this time.

This proposal affects end-use products containing DDAC registered in Canada. Once the final re-evaluation decision is made, the registrant will be instructed on how to address any new requirements.

For DDAC end-use products that contain other active ingredient(s) under re-evaluation, the review(s) for these active ingredient(s) will be included in separate document(s). Note that the antisapstain uses of DDAC are being reviewed together with all antisapstain active ingredients under a separate initiative within the PMRA and are not part of this re-evaluation decision.

This Proposed Re-evaluation Decision is a consultation document[1] that summarizes the science evaluation for DDAC and presents the reasons for the proposed re-evaluation decision. It also proposes additional risk-reduction measures to further protect human health and the environment.

The information is presented in two parts. The Overview describes the regulatory process and key points of the evaluation, while the Science Evaluation provides detailed technical information on the assessment of DDAC.

The PMRA will accept written comments on this proposal up to 45 days from the date of publication of this document. Please forward all comments to Publications (see contact information indicated on the cover page of this document).

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1 "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*.

What Does Health Canada Consider When Making a Re-evaluation Decision?

The PMRA's pesticide re-evaluation program considers the potential risks, as well as value, of pesticide products to ensure they meet modern standards established to protect human health and the environment. Regulatory Directive DIR2001-03, *PMRA Re-evaluation Program*, presents the details of the re-evaluation activities and program structure.

DDAC cluster, a group of active ingredients in the current re-evaluation cycle, has been re-evaluated under Re-evaluation Program 1. This program relies as much as possible on foreign reviews, typically United States Environmental Protection Agency (USEPA) Reregistration Eligibility Decision (RED) documents. For products to be re-evaluated under Program 1, the foreign review must meet the following conditions:

- it covers the main science areas, such as human health and the environment, that are necessary for Canadian re-evaluation decisions;
- it addresses the active ingredient and the main formulation types registered in Canada; and
- it is relevant to registered Canadian uses.

Given the outcome of foreign reviews and a review of the chemistry of Canadian products, the PMRA will propose a re-evaluation decision and appropriate risk-reduction measures for Canadian uses of an active ingredient. In this decision, the PMRA takes into account the Canadian use pattern and issues (e.g. the federal Toxic Substances Management Policy [TSMP]).

Based on the health and environmental risk assessments published in a 2006 RED, the USEPA concluded that DDAC was eligible for reregistration provided that risk-reduction measures were adopted. The PMRA compared the American and Canadian use patterns and found that the USEPA assessments described in the RED were an adequate basis for the proposed Canadian re-evaluation decision.

For more details on the information presented in this overview, please refer to the Science Evaluation of this consultation document.

What Is DDAC?

DDAC is a biocide registered in Canada under the authority of the *Pest Control Products Act* for the control of algae, bacteria, fungi or molluscs in the following use sites: indoor hard surfaces (e.g. floors, walls, countertops), other indoor surfaces (e.g. carpet, laundry), industrial process fluids (e.g. open cooling water tower system, oil field water flood or salt water disposal systems, recirculating water cooling towers) and wood. Wood uses of DDAC are not included in this re-evaluation.

Health Considerations

Can Approved Uses of DDAC Affect Human Health?

DDAC is unlikely to affect your health when used according to the revised label directions.

People could be exposed to DDAC by working as a mixer/loader/applicator or if in contact with treated material. The PMRA considers two key factors when assessing health risks: the levels at which no health effects occur and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (e.g. children and nursing mothers). Only uses for which exposure is well below levels that cause no effects in animal testing are considered acceptable for continued registration.

The USEPA concluded that DDAC was unlikely to affect human health provided that risk-reduction measures were implemented. These conclusions apply to the Canadian situation, and equivalent risk-reduction measures are required.

Environmental Considerations

What Happens When DDAC Is Introduced Into the Environment?

DDAC is unlikely to affect non-target organisms when used according to the revised label directions.

Certain aquatic organisms could be exposed to DDAC in the environment. Environmental risk is assessed by the risk quotient method—the ratio of the estimated environmental concentration to the relevant effects endpoint of concern. The resulting risk quotients are compared to corresponding levels of concern. A risk quotient less than the level of concern is considered a negligible risk to non-target organisms, whereas a risk quotient greater than the level of concern indicates some degree of risk.

The USEPA concluded that the reregistration of DDAC was acceptable provided risk-reduction measures to further protect the environment were implemented. These conclusions apply to the Canadian situation, and equivalent risk-reduction measures are currently in place in Canada.

Measures to Minimize Risk

Labels of registered pesticide products include specific instructions for use. Directions include risk-reduction measures to protect human and environmental health. These directions must be followed by law. As a result of the re-evaluation of DDAC, the PMRA is proposing further risk-reduction measures for product labels.

Human Health

- Additional protective equipment to protect handlers

Environment

- Additional advisory label statements

Next Steps

Before making a final re-evaluation decision on DDAC, the PMRA will consider all comments received from the public in response to this consultation document. The PMRA will then publish a Re-evaluation Decision[2] that will include the decision, the reasons for it, a summary of comments received on the proposed decision and the PMRA's response to these comments.

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2 "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*.

Science Evaluation

1.0 Introduction

Didecyl dimethyl ammonium chloride (DDAC) is registered in Canada as an algicide, sanitiser, bactericide, bacteriostat, mildew inhibitor, slimicide, molluscicide and preservative.

Following the re-evaluation announcement of DDAC, the registrants of the technical grade active ingredients in Canada indicated that they intended to provide continued support for all uses included on the labels of commercial and domestic end-use products in Canada.

The Pest Management Regulatory Agency (PMRA) used recent assessments of DDAC from the United States Environmental Protection Agency (USEPA). The USEPA Reregistration Eligibility Decision (RED) document for DDAC, dated August 2006, as well as other information on the regulatory status of DDAC in the United States can be found on the USEPA Pesticide Registration Status page at www.epa.gov/pesticides/reregistration/status.htm.

2.0 The Technical Grade Active Ingredients, Their Properties and Uses

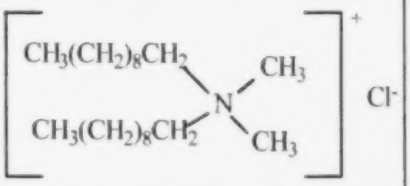
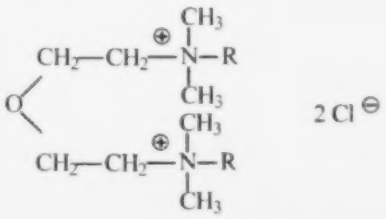
2.1 Identity of the Technical Grade Active Ingredients

The Canadian DDAC cluster is comprised of four chemicals that are structurally similar quaternary ammonium compounds. Table 2.1.1 below provides information on each individual member of this cluster.

Didecyl Dimethyl Ammonium Chloride and Oxydiethylene Bis (Alkyl Dimethyl Ammonium Chloride)
Based on the manufacturing process, the products are not expected to contain impurities of human health or environmental concern as identified in Regulatory Directive DIR98-04, *Chemistry Requirements for the Registration of a Technical Grade of Active Ingredient or an Integrated System Product*, Section 2.13.4 or Toxic Substances Management Policy (TSMP) Track 1 substances as identified in Regulatory Directive DIR99-03, *The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy*, Appendix II.

Dioctyl Dimethyl Ammonium Chloride and Octyl Decyl Dimethyl Ammonium Chloride
Currently in Canada, no technical grade active ingredients containing solely dioctyl dimethyl ammonium chloride or octyl decyl dimethyl ammonium chloride is registered. Rather, the technical grade active ingredients are a co-formulation of dioctyl dimethyl ammonium chloride, octyl decyl dimethyl ammonium chloride, didecyl dimethyl ammonium chloride and/or *N*-alkyl (40% C12, 50% C14, 10% C16) dimethyl benzyl ammonium chloride. Impurities of concern to human health or the environment cannot be assessed until a detailed manufacturing process for each active ingredient has been provided.

Table 2.1.1 Members of the DDAC Cluster

CAS Number	Common Name	Chemical Name	Structural Formula
7173-51-5	Didecyl Dimethyl Ammonium Chloride	**IUPAC name:** 1-decanaminium, *N*-decyl-*N*,*N*-dimethyl chloride	
68607-28-3	Oxydiethylene bis (alkyl dimethyl ammonium chloride)	**CAS name:** Oxydiethylenebis(alkyl-dimethyl ammonium chloride)	
N/A	Dioctyl dimethyl ammonium chloride	N/A	N/A
N/A	Octyl decyl dimethyl ammonium chloride	N/A	N/A

2.2 Comparison of Use Patterns in Canada and the United States

DDAC is a group of biocides registered in Canada for use against algae, bacteria, fungi or molluscs in the following use sites: indoor hard surfaces (e.g. floors, walls, countertops), other indoor surfaces (e.g. carpets, laundry), industrial process fluids (e.g. open cooling water tower systems, oil field water flood or salt water disposal systems, recirculating water cooling towers) and wood.

Ten technical, 12 manufacturing concentrate, 38 commercial products and 1 domestic product containing DDAC are currently registered in Canada. All products are formulated as solution except two end-use products formulated as emulsifiable concentrates. Currently registered products containing DDAC are listed in Appendix I, Table 1. All current uses are being supported by the registrants.

DDAC products are widely used and have a large number of use patterns. The USEPA has representative scenarios for each use site to typify the vast DDAC uses. The risk assessment discussed in the RED was performed on a number of representative scenarios believed to provide high-end degrees of dermal, inhalation or incidental ingestion exposure.

The Canadian registered uses of DDAC are compared to American representative uses. The Canadian use patterns are encompassed by those of the United States. Therefore, it was concluded that the USEPA RED for DDAC is an adequate basis for the re-evaluation of Canadian uses of DDAC.

The antisapstain uses of DDAC are being reviewed together with all antisapstain active ingredients under a separate initiative within the PMRA and are not included in this document.

It should be noted that certain uses of DDAC are regulated under the *Food and Drugs Act* and are not included in this assessment. However, these uses were assessed by the USEPA. The uses are for commercial sanitiser uses in food manufacturing/processing plants and areas in which food is prepared or kept (e.g. food processing equipment, food utensil and drinking glass)

3.0 Impact on Human Health and the Environment

In their 2006 RED, the USEPA concluded that end-use products formulated with DDAC met the safety standard under the American *Food Quality Protection Act* and would not pose unreasonable risks or adverse effects to humans and the environment if used according to the amended product labels.

3.1 Human Health

Toxicology studies in laboratory animals describe potential health effects resulting from various levels of exposure to a chemical and identify dose levels at which no effects are observed. Unless there is evidence to the contrary, it is assumed that effects observed in animals are relevant to humans and that humans are more sensitive to effects of a chemical than the most sensitive animal species.

In Canada, exposure to DDAC may occur working as a mixer/loader/applicator or by contacting treated material. When assessing health risks, the PMRA considers two key factors: the levels at which no health effects occur and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (e.g. children and nursing mothers).

3.1.1 Occupational Exposure and Risk Assessment

Occupational risk is estimated by comparing potential exposures with the most relevant endpoint derived from the toxicology studies used to calculate the margin of exposure (MOE). This is compared to a target MOE incorporating safety factors protective of the most sensitive subpopulation. If the calculated MOE is less than the target MOE, it does not necessarily mean that exposure will result in adverse effects, but mitigation measures to reduce risk would be required.

Workers can be exposed to DDAC through mixing, loading or applying the pesticide and when handling treated material.

3.1.1.1 Mixer/Loader/Applicator Exposure and Risk

No dermal endpoint for systemic effects was selected for DDAC because no systemic effects were identified. Therefore, the USEPA did not conduct a quantitative assessment of occupational risk from dermal exposure. However, the acute toxicity data for the technical grade active ingredients of the DDAC cluster show that they are severe eye and skin irritants. The USEPA considered the existing personal protective equipment requirements on labels adequate to mitigate the irritation effect of DDAC.

Several handler scenarios associated with the potential inhalation exposure were identified in the RED. Among those, the following were considered relevant to the Canadian situation:

- Liquid pour;
- Mopping;
- Wiping;
- Low-pressure hand wand;
- Trigger pump spray;
- Liquid/metering pump;
- High-pressure/high-volume spray and medium-pressure spray.

Maximum application rates as stated on the product labels, surrogate unit exposure values from the Chemical Manufacturers Association antimicrobial exposure study, the Pesticide Handlers Exposure Database (PHED) and estimates of the daily amount handled were used to assess the occupational risks via inhalation.

The USEPA considered the duration of exposure to be short- and intermediate-term. The inhalation endpoint (all durations) based on toxicity studies in rats and in dogs (see Appendix II) was used in the assessment. Given the adverse effect for this endpoint was based on clinical signs of toxicity in maternal rats, an adult female body weight (i.e. 60 kg) was used in extrapolating the occupational risks. A target MOE of 100 was considered to be protective for all exposure durations (taking into consideration an uncertainty factor of 10-fold for intraspecies variability and 10-fold for interspecies extrapolation).

MOEs for all occupational scenarios listed above were above or at close proximity to the target MOE ranging from 91 to 190 000. Risks were not of concern to the USEPA and no additional risk-mitigation measures were required.

In the RED, the assessment of risk associated with the once-through cooling water use was based on the metered pump application method and an application rate of 5.8 ppm. Typically, in Canada, antimicrobials used in once-through cooling water systems can be either poured or pumped. Currently, only one product containing DDAC is registered in Canada for this use at a maximum rate of 10 ppm. For the metered pump application method, the inhalation MOE estimated for the American scenario is large enough to account for the difference in the use rate between United States and Canada. For the open pour application method, the short-term inhalation MOE (15 000) estimated by the USEPA for the swimming pool scenario is protective enough to account for the rate and volume for the once-through cooling water tower scenario.

The USEPA addressed the DDAC dermal irritation effect through protective equipment requirements on its labels. In Canada, not all end-use product labels recommend personal protective equipment. Therefore, the PMRA requires, as a minimum, goggles or a face shield, chemical-resistant gloves, long pants, long-sleeved shirt, shoes and socks for workers handling liquid concentrates. The proposed label amendments are listed in Appendix III.

3.1.1.2 Postapplication Exposure and Risk

The USEPA determined that occupational postapplication dermal and inhalation exposure associated with the above described scenarios was negligible. This conclusion is considered applicable to the Canadian situation.

3.1.2 Non-Occupational Exposure and Risk Assessment

3.1.2.1 Residential Exposure

Residential exposure is estimated using the MOE approach described in Section 3.1.1. The toxicological endpoints the USEPA selected for assessment of risk from residential exposure are summarized in Appendix II.

Homeowners can be exposed to DDAC when applying a domestic class product or by contacting the treated material. Toddlers can also be exposed through contacting treated materials.

3.1.2.1.1 Residential Handlers

In the United States, DDAC is registered as an antimicrobial for use in swimming pools and on indoor surfaces, such as hard floors, carpets, walls, bathroom fixtures, trash cans and toilet bowls. It is also registered as a liquid laundry additive and as a portable humidifier algaecide/bacteriocide. In Canada, only one product is registered for use by residential handlers. This ready-to-use formulation is to be sprayed directly on washable non-porous surfaces for the purpose of sanitising.

Among the potential dermal and inhalation exposure scenarios assessed in the RED for handler risks in residential settings, the following scenario is considered to be relevant to the Canadian situation:

- wiping and trigger pump sprays applications on indoor hard surfaces

In the USEPA assessment, residential handlers were assumed to complete all elements of an application without wearing protective clothing. Dermal and inhalation unit exposure values were taken from the PHED and the Chemical Manufacturers Association Antimicrobial Exposure Assessment Study. The average body weight of a female adult handler was used in inhalation risk assessment because of the female-specific adverse effects from the toxicological endpoint.

The USEPA considered residential handlers exposure to be short-term (1–30 days) because the handler tasks were assumed to be episodic and the homeowners were unlikely to use solely DDAC products for varying activities. MOEs greater than or equal to 100 for the inhalation route of exposure did not represent risks of concern. A target MOE of 10 was considered appropriate for the dermal route of exposure because the dermal toxicological endpoint was dermal irritation, not a systemic effect, and because the effect is considered reversible and short-term.

Inhalation MOEs for wiping and trigger pump spray scenarios were greater than the target MOE of 100. Therefore, the inhalation risk did not exceed the USEPA's level of concern. For general and heavy duty cleaning activities, the dermal MOEs were greater than the target MOE of 10. However, the estimated dermal MOE for heavy duty cleaning use by wiping was below the target. As a result, the USEPA required a reduction of rate from 2400 ppm a.i. to 800 ppm a.i.

The RED adequately addressed potential inhalation exposure scenarios associated with Canadian residential handlers. Although residential handler's dermal exposure from the DDAC heavy duty cleaning use by wiping was below the USEPA target MOE of 10, this assessment result is not considered relevant to the Canadian scenario because the Canadian use rate (200 ppm) is 12-fold less than the American rate.

Based on this, the PMRA requires no further mitigation measures with respect to residential handler exposure. As a good hygiene practice, residential handlers are recommended to wear rubber gloves when handling the product.

3.1.2.1.2 Residential Postapplication Exposures

In the United States and Canada, DDAC is registered for use on hard surfaces, on carpets, in laundries, and on wood. In Canada, these uses are classified as "commercial" and can result in potential residential postapplication exposure only.

Among the scenarios chosen by the USEPA to represent high-end exposure, the following are considered to be relevant to the Canadian situation:

- crawling on treated hard surfaces and carpets (dermal and incidental oral exposure to children); and
- wearing treated clothing (dermal exposure to adults and children and incidental oral exposure to children).

The calculated dermal and oral MOEs were above the target MOEs of 10 and 100, respectively. Therefore, risk from dermal contacting treated materials and children's incidental ingestion of DDAC were not of concern to the USEPA.

The RED adequately addressed potential exposure scenarios associated with the Canadian uses of DDAC on treated hard floors and carpets. Although DDAC is not used in Canada to treat carpet in homes, it can be used in institutional settings. Thus, the conclusions derived from the American RED are considered applicable to the Canadian situation. The Canadian rate (1500 ppm) used on carpet is higher than the rate used in the RED assessment (1056 ppm), however, MOEs calculated by the USEPA are protective enough to account for the difference in rate between the United States and Canada.

Canadians can be exposed to DDAC postapplication when used in laundries in institutional and industrial settings. The potential exposure scenarios were adequately addressed in the RED through the American residential uses of DDAC as a laundry additive. The Canadian use rate is lower than the rate used in the USEPA assessment. No further mitigation measures are required for these uses.

In addition, the USEPA also assessed the risk from postapplication exposure from pressure treated lumber. This, however, is not considered relevant to the Canadian wood treatment uses of DDAC. The Canadian registered DDAC uses on wood are for sapstain control, for joinery preservation, and for preventive and remedial wood preservation. The antisapstain uses of DDAC are being reviewed under a separate initiative within the PMRA together with all antisapstain active ingredients. These uses are not included in this document. Consumers are not expected to be exposed to DDAC as a result of joinery treatment because the wood is treated during the manufacturing process and is used mainly for window and door components or exterior non-structural decorative wood joinery items. As for preventive and remedial wood preservation uses, the products are applied by occupational handlers, and the residential postapplication exposure is expected to be minimal because product labels prohibit the use in habitable portions of dwellings or where prolonged human exposure may occur.

3.1.2.2 Exposure From Food and Drinking Water

Acute dietary risk is estimated by determining how much of a pesticide residue may be ingested with the daily diet and comparing this potential exposure to an acute reference dose, which is the dose at which an individual could be exposed over the course of one day and expect no adverse health effects. The acute reference dose is referred to as the ARfD in Canada, and, in the RED, it is expressed as the acute population adjusted dose (aPAD). The ARfD or aPAD is based on a relevant endpoint from toxicology studies and on safety factors protective of the most sensitive subpopulation.

Chronic dietary risk is estimated by determining how much of a pesticide residue may be ingested with the daily diet and comparing this potential exposure to an acceptable daily intake, which is the dose at which an individual could be exposed over the course of a lifetime and expect no adverse health effects. The acceptable daily intake is referred to as the ADI in Canada, and, in the RED, it is expressed as the chronic population adjusted dose (cPAD). The cPAD and ADI are based on a relevant endpoint from toxicology studies and on safety factors protective of the most sensitive subpopulation.

In Canada, DDAC can be used as a commercial sanitiser in food processing plants and in areas where food is prepared or kept (e.g. food processing equipment, dairy equipment, food utensils, dishes, glasses, etc.). This use is regulated under the *Food and Drugs Act* and are not included in this assessment.

In both the United States and Canada, DDAC can be used in mushroom houses. The USEPA decided that residues of DDAC following its use in mushroom facilities was negligible. Both the American and Canadian labels have instructions not to apply DDAC on mushroom crops, compost or casing.

DDAC can be used in Canada in homes to sanitize food-contact surfaces. Residues of DDAC on these treated surfaces could migrate to food coming into contact with these surfaces and be ingested by humans.

DDAC uses on food contact surfaces (i.e. utensils, countertops) in food handling establishments, food processing facilities and in food bottling or packaging, were considered by the USEPA to represent the "worst-case" dietary exposure scenarios; therefore, dietary risk due to food was assessed based on these uses.

An acute endpoint of concern was identified by the USEPA only for females of child bearing age (13–50), and an acute dietary risk due to food was derived for this population subgroup only. It was estimated to occupy 3.32% of the aPAD. The chronic dietary exposures for adult males; adult females, and the most highly exposed population subgroup (three-year old toddlers) were estimated to make up 2.84, 3.32 and 13.3% of the cPAD, respectively. Risk estimates were below the USEPA's level of concern.

The American use pattern encompasses the Canadian use pattern; consequently, the USEPA assessment on risks from food is considered applicable to the Canadian situation.

Dietary Risks from Drinking Water

The USEPA drinking water assessment considered all DDAC uses described in the RED. It concluded that the DDAC uses were not expected to significantly contaminate drinking water sources. Therefore, the dietary risk from drinking water was deemed negligible and was not quantified. This conclusion is considered applicable to the Canadian situation.

3.1.2.3 Aggregate Risk Assessment

The assessment of aggregate risk combines the different routes of exposure (i.e. from food, water and residential exposures).

Two key factors were considered by the USEPA when selecting exposure scenarios for incorporation into the aggregate assessment: the use pattern of the products and the probability of co-occurrence. The acute and chronic aggregate risks combine risks from food and drinking water exposure only. Drinking water exposure was considered negligible and Section 3.1.2.2 presents the acute and chronic dietary risk estimates from food.

Short-term and intermediate aggregate risk assessments assumed contributions from food, drinking water and non-occupational exposure (dermal, inhalation, incidental ingestion). In the RED, the following exposure scenarios were considered to likely co-occur on a short-term basis.

Adults:

- Chronic dietary
- Applying cleaning products via mopping, wiping and trigger pump spray (dermal, inhalation)
- Wearing treated clothing (dermal)

Children:

- Chronic dietary
- Postapplication from cleaning product on carpets (oral ingestion, dermal)
- Wearing treated clothing (oral ingestion, dermal)

Exposures via oral, dermal and inhalation routes were not aggregated because the DDAC toxicological endpoints for these three routes were based on different toxic effects. Only exposures co-occurring via the same route were aggregated.

For these exposures via oral and inhalation routes considered in the RED, the MOEs were greater than the target MOEs for both adults and children. Therefore, risks were not of concern to the USEPA for those scenarios. The MOE from aggregation of dermal exposures was below the target. To mitigate the potential risks associated with the heavy duty cleaning scenario, the USEPA required that application rate be reduced from 2400 ppm to 800 ppm.

The Canadian DDAC use pattern is less extensive than the American pattern (e.g. heavy duty cleaning is not a likely scenario.). For the relevant use sites included in the aggregate risk assessment, the Canadian use rates are lower than American use rates. Therefore, the USEPA assessment is considered to address potential Canadian aggregate scenarios, and no further mitigation measures are required.

3.1.3 Cumulative Effects

The USEPA has not determined whether DDAC has a common mechanism of toxicity with other substances or whether it shares a toxic metabolite produced by other substances. Therefore, it was assumed that DDAC does not share a common mechanism of toxicity with other substances, and a cumulative risk assessment was not required.

3.2 Environment

3.2.1 Environmental Fate

Based on the available data submitted to the USEPA, DDAC is hydrolytically stable under abiotic and buffered solutions over the pH 5–9 range, with an estimated half-life between 175 and 506 days. DDAC is also stable to photodegradation in pH 7 buffered aqueous solution. Even in the presence of a photosensitiser (acetone), DDAC degradation is minimal with an estimated half-life of 227 days based on results for the sensitized irradiated solutions. DDAC is also photolytically stable in soil with a calculated half life of 132 days.

DDAC is stable to microbial degradation in aquatic systems. The calculated DDAC aerobic and anaerobic half-lives in flooded river water are 180 and 261 days, respectively. DDAC is also stable in aerobic soils, with a calculated half-life of 1048 days.

The USEPA concluded that DDAC is immobile in soil. It has a strong tendency to bind to sediment/soil. Because of this, DDAC is not expected to contaminate surface and ground waters. Hence, bioconcentration of DDAC in aquatic organisms is not likely to occur.

The USEPA concluded that, except for once-through cooling water tower and wood treatment uses, DDAC was not likely to result in an unacceptable ecological risk to non-target organisms because of minimal exposure potential. Therefore, quantitative risk assessments for these uses were not performed.

The once-through cooling tower use has the potential for direct release or runoff of DDAC into the aquatic system. It was considered to represent the worst-case exposure scenario for freshwater and estuarine/marine aquatic organisms and plants. A screening level risk assessment was performed by the USEPA.

To assess the ecological risk of DDAC to wildlife, the USEPA calculated risk quotients (RQs) based on appropriate toxicity endpoints and expected environmental concentrations (EECs). It then compared the resulting RQs to corresponding levels of concern (LOCs).

Exposure from once-through cooling water tower use was estimated using a Tier I Probabilistic Distribution Model. An average sized plant was modelled as being located on small, average and large rivers, and downstream chemical concentrations from a chemical discharge were calculated, assuming a constantly changing flow rate.

The Tier I assessment indicated that DDAC use resulted in acute and chronic risks to freshwater fish and acute risk to other aquatic animals at all modelled dosages.

Terrestrial wildlife was not expected to be impacted from the once-through cooling tower use.

In order to reduce the environmental risk from the once-through cooling water tower use, the USEPA required that applications be limited to no more than four per year. In addition, all labels were required to carry statements indicating that discharge of effluent containing DDAC into aquatic systems be prohibited, unless permit requirements were met and the permitting authorities were notified in writing. Directions for bentonite clay treatment (to deactivate DDAC) were also to be provided. Bentonite clay was found to be an effective agent in reducing the amount of DDAC in the effluents/runoffs, due to its strong tendency to bind DDAC. In addition, the USEPA will require monitoring data to confirm its decision.

The RED adequately addressed potential environmental exposure scenarios associated with the Canadian once-through cooling water tower use of DDAC. The Canadian product is applied at a maximum rate of 10 ppm, which is lower than the rates used in the USEPA assessment. In addition, the measures required in the United States are already in place in Canada, i.e. the Canadian label includes the following:

- restriction of the maximum number of application to no more than four times a year;
- deactivation of DDAC in effluents by bentonite clay before discharge; and
- application by suppliers only at provincially approved sites.

To further protect the environment, the PMRA requires that additional effluent discharge statements and environmental hazard statements be included on the labels of all products with uses that could lead to discharges into water bodies.

Label amendments are described in detail in Appendix III.

3.2.2 Toxic Substances Management Policy Considerations

The management of toxic substances is guided by the 1995 federal TSMP, which puts forward a preventive and precautionary approach to deal with substances that enter the environment and could harm the environment or human health. The policy provides decision makers with direction and sets out a science-based management framework to ensure that federal programs are consistent with its objectives. One of the key management objectives is the virtual elimination from the environment of toxic substances that result predominantly from human activity and that are persistent and bioaccumulative. These substances are referred to in the policy as Track 1 substances.

The federal TSMP and PMRA Regulatory Directive DIR99-03, *The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy*, were taken into account during the re-evaluation of DDAC. The PMRA has reached the following conclusions.

- DDAC was found to be hydrolytically stable under abiotic and buffered conditions over the pH 5–9 range in aquatic environment (half-lives: 175–506 days) and stable to photodegradation in pH 7 buffered aqueous solutions.

- DDAC is not expected to be bioaccumulative. According to the RED, mean steady state bioconcentration factors for DDAC were determined to be 38-fold, 140-fold and 81-fold in the edible, non-edible and whole body fish tissue, respectively. Therefore, DDAC is not a candidate for Track 1 classification.

- Based on a review of the available chemistry information (see Section 2.1), the technical products containing either didecyl dimethyl ammonium chloride or oxydiethylene bis (alkyl dimethyl ammonium chloride) are not expected, at this time, to contain impurities of toxicological concern as identified in Regulatory Directive DIR98-04 or TSMP Track 1 substances as identified in Regulatory Directive DIR99-03, Appendix II. However, impurities of human health or environmental concern cannot be assessed at this time for the co-formulated technical grade active ingredients containing dioctyl dimethyl ammonium chloride and octyl decyl dimethyl ammonium chloride. A detailed manufacturing process for each active is required for this assessment.

Formulant issues are being addressed through PMRA formulant initiatives and Regulatory Directive DIR2006-02, *Formulants Policy and Implementation Guidance Document,* published on 31 May 2006.

4.0 Proposed Re-evaluation Decision

The PMRA has determined that DDAC is acceptable for continued registration with the implementation of the proposed risk-reduction measures. These measures are required to further protect human health and the environment. The labels of Canadian end-use products must be amended to include the label statements listed in Appendix III. A submission to implement label revisions will be required within 90 days of finalization of the re-evaluation decision.

The antisapstain uses of DDAC are being reviewed together with all antisapstain active ingredients under a separate initiative within the PMRA and are not part of this re-evaluation decision. Additional data may be required as a result of the antisapstain review.

5.0 Supporting Documentation

PMRA documents, such as Regulatory Directive DIR2001-03, and data code tables can be found on our website at www.pmra-arla.gc.ca. PMRA documents are also available through the Pest Management Information Service. Phone 1-800-267-6315 within Canada or 1-613-736-3799 outside Canada (long distance charges apply); fax: 613-736-3798; e-mail: pmra_infoserv@hc-sc.gc.ca.

The federal TSMP is available through Environment Canada's website at www.ec.gc.ca/toxics.

The USEPA RED document for DDAC cluster is available on the USEPA Pesticide Registration Status page at www.epa.gov/pesticides/reregistration/status.htm.

List of Abbreviations

µg	microgram
ADI	acceptable daily intake
a.i.	active ingredient
aPAD	acute population adjusted dose
ARfD	acute reference dose
bw	body weight
CAS	Chemical Abstracts Service
cm^2	centimetre(s) squared
cPAD	chronic population adjusted dose
DDAC	didecyl dimethyl ammonium chloride cluster
EEC	expected environmental concentration
FQPA	*Food Quality Protection Act*
g	gram(s)
IUPAC	International Union of Pure and Applied Chemistry
kg	kilogram(s)
L	litre(s)
LOAEL	lowest observed adverse effect level
LOC	level of concern
mg	milligram(s)
N/A	not available
MOE	margin of exposure
NOAEL	no observed adverse effect level
pH	-log10 hydrogen ion concentration
PHED	Pesticide Handlers Exposure Database
PMRA	Pest Management Regulatory Agency
PPE	personal protective equipment
ppm	parts per million
PRVD	Proposed Re-evaluation Decision
RED	Reregistration Eligibility Decision
RQ	risk quotient
SF	safety factor
TSMP	Toxic Substances Management Policy
UF	uncertainty factor
USEPA	United States Environmental Protection Agency

Appendix I Registered Products Containing DDAC as of 25 June 2008

Registration Number	Marketing Class	Registrant	Product Name	Formulation
13148	Commercial	Pace Chemicals Ltd.	Kleengrow	Solution
15206	Commercial	Nalco Canada Company	Formula AG-411 Industrial Liquid Microbiocide	Solution
17632	Commercial	Guardian Chemicals Inc.	Aquaguard 600 Water Treatment Microbiocide	Solution
17770	Commercial	Lonza Inc.	Lonza Water Treatment Microbiocide	Solution
19427	Commercial	Baker Petrolite Corporation	Magnicide 785 Industrial Bactericide	Solution
20275	Commercial	Baker Petrolite Corporation	Magnicide 509 Industrial Bactericide	Solution
20321	Technical	Lonza Inc.	Bardac 2280 QUAT	Solution
20339	Commercial	Johnsondiversey Canada Inc.	Mildiquat 50 Liquid Laundry Mildew Inhibitor	Solution
21723	Technical	Lonza Inc.	Bardac 205 M	Solution
21726	Technical	Lonza Inc.	Bardac 208M	Solution
21753	Commercial	Kop-Coat Inc.	NP-1 Sapstain Control Chemical	Emulsifiable concentrate
21893	Manufacturing concentrate	Lonza Inc.	Bardac 2250	Solution
21897	Technical	Lonza Inc.	Bardac 2080	Solution
21899	Technical	Lonza Inc.	Bardac 2050	Solution

Registration Number	Marketing Class	Registrant	Product Name	Formulation
21939	Commercial	Arch Wood Protection Canada Corp.	F2 Concentrate T2154 Liquid Microbiocide	Emulsifiable concentrate
22224	Commercial	Lonza Inc.	Lonza 205M Water treatment microbiocide	Solution
22613	Commercial	Produits Chimiques Magnus Ltée	Magnatrol 443-A	Solution
22836	Commercial	Nalco Canada Company	H-130 Micobiocide	Solution
23113	Technical	Baker Petrolite Corporation	X-Cide 370 Industrial Microbiocide	Solution
23612	Commercial	Edmar Chemical Company	Endew	Solution
23947	Manufacturing concentrate	Lonza Inc.	Bardac 2250 Quat Concentrate Liquid Germicide	Solution
24025	Commercial	Lonza Inc.	Lonza Carpet Sanitizer CS-202	Solution
24041	Commercial	3M Canada Company	3M Sanitizer Concentrate	Solution
24043	Manufacturing concentrate	Lonza Inc.	FMB-1210-8 Quat Concentrated Liquid Germicide	Solution
24044	Manufacturing concentrate	Lonza Inc.	FMB-1210-5 Quat Concentrated Liquid Germicide	Solution
24595	Commercial	Lonza Inc.	Nalco H-130M Molluscicide	Solution
24764	Commercial	Baker Petrolite Corporation	X-Cide 402 Liquid Bacteriocide	Solution

Registration Number	Marketing Class	Registrant	Product Name	Formulation
24805	Technical	Mason Chemical Company	Maquat 4480-E	Solution
24812	Manufacturing concentrate	Mason Chemical Company	Maquat 4450-E	Solution
24998	Commercial	Baker Petrolite Corporation	X-Cide 107W Industrial Liquid Bactericide	Solution
25054	Commercial	Kay Chemical International Inc.	Kay Liquid Sanitizer	Solution
25106	Technical	Stepan Company	Stepan BTC 1010-80% Concentrated Germicide	Solution
25276	Commercial	Osceola Supply Inc.	Verticide	Solution
25407	Technical	Mason Chemical Company	Maquat 40-80	Solution
25408	Manufacturing concentrate	Mason Chemical Company	Maquat MQ 615M	Solution
25409	Manufacturing concentrate	Mason Chemical Company	Maquat MQ 624M	Solution
25410	Manufacturing concentrate	Mason Chemical Company	Maquat 40-50	Solution
25427	Technical	Stepan Company	BTC 818-80% Concentrated Germicide	Solution
25664	Commercial	Kai R. Spangerberg EFTF I/S	Boracol 20-2 BD preventive and remedial wood preservative/ structures	Solution
25665	Commercial	Kai R. Spangerberg EFTF I/S	Boracol 20-2 BD preventive and remedial wood preservative/ structures	Solution

Registration Number	Marketing Class	Registrant	Product Name	Formulation
25703	Commercial	Kay Chemical International Inc.	Kay Surface Sanitizer	Solution
25744	Commercial	Diacon Technologies Ltd.	Mycostat Q	Solution
26159	Manufacturing concentrate	Stepan Company	BTC 1010 Concentrated Germicide	Solution
26167	Manufacturing concentrate	Stepan Company	BTC 818-50% Concentrated Germicide	Solution
26168	Manufacturing concentrate	Stepan Company	Stepan BTC 888 Concentrated Germicide	Solution
26169	Manufacturing concentrate	Stepan Company	Stepan BTC 885 Concentrated Germicide	Solution
26250	Commercial	Mason Chemical Company	Maquat SSC Sapstain Control	Solution
26362	Commercial	Innovative Chemical Technologies Canada Ltd.	Econo-Cide B1002	Solution
26866	Commercial	Innovative Chemical Technologies Canada Ltd.	Econo-Cide B1001	Solution
26948	Commercial	Innovative Chemical Technologies Canada Ltd.	Econo-Cide B1000	Solution
26985	Commercial	Kop-Coat Inc.	NP-2 Sapstain Control Chemical	Solution
27328	Commercial	Unichem - A Division of BJ Services	Alpha 133	Solution

Registration Number	Marketing Class	Registrant	Product Name	Formulation
27493	Commercial	Buckman Laboratories of Canada Ltd.	Prosan 17 Liquid Microbicide	Solution
27632	Commercial	Arch Wood Protection Canada Corp.	Antiblu F2 Concentrate T2154 Liquid Microbicide	Solution
27746	Commercial	Servicemaster of Canada Ltd.	Servicemaster Sanimaster Carpet Sanitizer	Solution
27828	Commercial	Baker Petrolite Corp.	X-Cide 370 Industrial Microbiocide	Solution
28425	Commercial	Ecolab Co.	82 Carpet Sanitizer	Solution
28484	Commercial	Microban Systems Inc.	Microban Clean Carpet Sanitizer Plus	Solution
28718	Domestic	Reckitt Benckiser Canada Inc.	Lysol Brand Daily Surface Sanitizer	Solution
28785	Commercial	Aquarian Chemicals Inc.	Aquarian M390	Solution
28789	Commercial	Washing Systems, LLC	Inhibit	Solution

Appendix II Toxicological Endpoints for DDAC Health Risk Assessments

Exposure Scenario	Dose (mg/kg bw/day)	UF/SF or MOE[a]	Study and Toxicological Effects
Acute Dietary (Females 13–50)	NOAEL = 10	FQPA SF = 1 UF = 100 (10-fold interspecies extrapolation, 10-fold intraspecies variation)	Prenatal Developmental Toxicity – Rat LOAEL = 20 mg/kg bw/day based on increased incidence of skeletal variations.
	aPAD = 0.1 mg/kg bw/day (females age 13+)		
Acute Dietary (General population)	An acute dietary endpoint for the general population was not identified in the database for DDAC.		
Chronic dietary (General population)	NOAEL = 10	FQPA SF = 1 UF = 100 (10-fold interspecies extrapolation, 10-fold intraspecies variation)	Chronic Toxicity Study – Dog LOAEL = 20 mg/kg bw/day based on increased incidence of clinical signs in male and females and decreased total cholesterol levels in females.
	cPAD = 0.1 mg/kg bw/day		
Incidental Oral (Short-term)	NOAEL = 10	Target MOE = 100 (10-fold interspecies extrapolation, 10-fold intraspecies variation) FQPA SF = 1	Prenatal Developmental Toxicity – Rat LOAEL = 20 mg/kg bw/day based on increased incidence of skeletal variations.
Incidental Oral (Intermediate-term)	NOAEL = 10	Target MOE = 100 (10-fold interspecies extrapolation, 10-fold intraspecies variation) FQPA SF = 1	Chronic Toxicity Study – Dog LOAEL = 20 mg/kg bw/day based on decreased total cholesterol levels in females.
Short-Term Dermal	NOAEL = 2 (8 µg/cm^2)[b]	Target MOE = 10 (3-fold interspecies extrapolation, 3-fold intraspecies variation)[d]	90-day Dermal Toxicity – Rat LOAEL = 6 mg/kg bw/day based on increased clinical and gross findings (erythema, edema, exfoliation, excoriation, and ulceration) beginning on day 4–5 of treatment.

Exposure Scenario	Dose (mg/kg bw/day)	UF/SF or MOE[a]	Study and Toxicological Effects
Intermediate- and Long-Term Dermal	No appropriate endpoint identified.		
Short-Term Inhalation	NOAEL[c] = 10	Target MOE = 100 (10-fold interspecies extrapolation, 10-fold intraspecies variation) FQPA SF = 1	Prenatal Developmental Toxicity – Rat LOAEL = 20 mg/kg bw/day based on increased incidence of skeletal variations.
Intermediate- and Long-Term Inhalation	NOAEL[c] = 10	Target MOE = 100 (10-fold interspecies extrapolation, 10-fold intraspecies variation) FQPA SF = 1	Chronic Toxicity Study – Dog LOAEL = 20 mg/kg bw/day based on decreased total cholesterol levels in females.

a UF/SF refers to total of uncertainty and/or safety factors for dietary assessments. MOE refers to desired margin of exposure for occupational or residential assessments.

b Short-term dermal endpoint = (2 mg/kg rat × 0.2 kg rat × 1000 µg/mg)/50 cm^2 area of rat dosed = 8 µg/cm^2

c An additional uncertainty factor of 10-fold is applied for use of an oral endpoint for route-to-route extrapolation to determine if a confirmatory inhalation toxicity study is warranted.

d The UF of 10 was chosen because the established endpoint is not for systemic toxic effect, but for dermal irritation, whose effect is considered reversible and short-term.

Appendix III Label Amendments for Products Containing DDAC

The label amendments presented below do not include all label requirements for individual end-use products, such as first aid statements, disposal statements, precautionary statements and supplementary protective equipment. Additional information on labels of currently registered products should not be removed unless it contradicts the label statements below.

A submission to request label revisions will be required within 90 days of finalization of the re-evaluation decision.

To further protect workers and the environment, the labels of end-use products in Canada must be amended to include the following statements.

For Commercial class products:

The following statements must be added to the **PRECAUTIONS** section of all product labels:

> When handling this concentrate wear goggles or a face shield, chemical-resistant gloves, long pants, a long-sleeved shirt, and shoes plus socks.

The following statements must be added to the **ENVIRONMENTAL HAZARDS** section for products with uses that could lead to discharges into water bodies:

> This product is toxic to fish and other aquatic organisms. It is not to be used in circumstances that would cause or allow it to enter lakes, streams, ponds, estuaries, oceans or other waters in contravention of federal or provincial regulatory requirements. Do not discharge effluent containing this product into sewer systems without previously notifying the sewage treatment plant authority. The requirements of applicable laws should be determined before using the product.

For the Domestic class products:

In the **PRECAUTIONS** section:

> It is recommended to wear rubber gloves when handling this concentrate.

References

List of Studies/Information Submitted by Registrant (Unpublished)

PMRA Document Number	Reference
1525883	Technical Chemistry File, QAK-SPN-1, Additional Chemistry for BTC 1010-80%., DACO: 2.99, DACO 2.14.
1583268	Technical Chemistry file QAK-MSN-3. Chemistry, Manufacturing Procedures, Specifications, Determination of alkyl chain length distribution of distilled alkyldimethylamines (ADMA) amine by gas chromatography., DACO: 2.1,2.11.1,2.12,2.13,2.14.1,2.14.2,2.14.3.
1268818	Manufacturing Summary, N/S, MRID: N/S, DACO: 2.11.1 CBI
1268820	Production Procedure, PR-IT-009, MRID: N/S, DACO: 2.11.3 CBI
1291635	2004, BTC 1010-80% Certificate of Analysis (11JAN05).pdf, N/S, MRID: N/S, DACO: 2.13.2 CBI
1312748	Technical Chemistry File - X-CIDE 370 INDUSTRIAL MICROBIOCIDE TECHNICAL, DACO: 2.99, DACO 2.14.
1312760	Technical Chemistry File - X-CIDE 370 INDUSTRIAL BACTERICIDE, DACO: 0.8,2.99, DACO 2.11, 2.13.4.